A Maxim Integrated Products Brand

78M6618 M-API Library User Guide

September 15, 2010
Rev. 1.00
UG_6618_029

Table of Contents

1 Introduction

This document describes the **M-API v2.01** firmware libraries available from Teridian for use with the 78M6618 AC power monitoring IC. These libraries are specifically designed for measurement and switch control of eight (8) single-phase AC outlets (same phase).

The firmware delivery is a set of metrology libraries that configure and operate the measurement front end (e.g. MUX, ADC, CE, etc.) and provides simplified access to measurement output data such as Power, Voltage, Current, accumulated Energy and Line Frequency. All measurement calculations are computed by the M-API library every accumulation interval and mapped to a dedicated block of registers reserved by the library.

Measurement data can be either directly accessed via the hardware slave SPI interface or made available to the user application via API calls. Access to library data via the SPI interface is limited to raw (unscaled) measurement values. A demo application making use of the M-API library set and serial UART interface is included with the delivery.

Timer functions using the hardware RTC are also available and can be accessed directly by the application. APIs specific to RTC are not available in the current library. Contact a Teridian representative for more information on non-Volatile RTC operation (e.g. battery backup modes).

1.1 Terminology

The following terminology is used throughout this document:

- CREEP – Threshold value where measurement outputs are squelched to zero.
- IMAX – External RMS current corresponding to 250 mVpk at the current input of the 78M6618. It should be set IMAX= $(Vpk/\sqrt{2})/R_{SENSE.}$
- VARs – Reactive Power (Q).
- VA – Apparent Power (S).
- VMAX - External RMS voltage corresponding to 250 mVpk at the voltage input of the 78M6618 (VA, VB). It must be set high enough to account for over-voltages.
- NB – Narrowband values.
- WB – Wideband values.

1.2 Library Measurement Equations

The integrated Compute Engine (CE) accumulates the raw samples from the ADC and provides to the 80515 MPU the critical **atomic measurements* needed to derive all other data. This consists of RMS Voltage, Voltage Sag Status, and AC Line Frequency data as well as RMS Current, Active Power, and Reactive Power for each outlet. The M-API library provides the application developer with two equation options for processing the atomic values before updating the libraries output data registers. One equation option is defined as “Narrowband” (***NB***) and the other is defined as “Wideband” (***WB***).

When using ***NB*** equations; RMS Voltage, Active Power, and Reactive Power data is provided by the CE and used to derive RMS Current, Apparent Power, and Power Factor in the MPU for each outlet. Harmonic content is not included in the reported current measurement.

**Voltage* (V_{RMS})	=	$\sqrt{\sum v(t)2}$
Current (I_{RMS})	=	S/V_{RMS}
**Active Power* (P)	=	$\sum (i(t) * v(t))$
**Reactive Power* (Q)	=	$\sum (i(t) * v(t)$ shift 90º)
Apparent Power (S)	=	$\sqrt{(P^2 + Q^2)}$
Power Factor (PF)	=	P/S

When using ***WB*** equations (recommended); RMS Voltage, RMS Current, and Active Power data provided by the CE is used to derive Reactive Power, Apparent Power, and Power Factor in the MPU for each outlet.

**Voltage* (V_{RMS})	=	$\sqrt{\sum v(t)2}$
**Current* (I_{RMS})	=	$\sqrt{\sum i(t)2}$
**Active Power* (P)	=	$\sum (i(t) * v(t))$
Reactive Power (Q)	=	$\sqrt{(S^2 – P^2)}$
Apparent Power (S)	=	$V_{RMS} * I_{RMS}$
Power Factor (PF)	=	P/S

1.3 Library Parameters

This section describes critical constants and variable parameters of the M-API library and their recommended usage.

1.3.1 Global Symbols

The following symbols are fixed constants for the M-API v2.01 firmware library:

Samples	: 3000
FS	: 2979
POWERSCALE	: 9.2454E-07
VRMS_MSCALE	: 6.0813E-05
IRMS_MSCALE	: 1.5203E-05

The following variables are unique to the sensor configuration and represent the real world values mapped to the upper range of the 78M6618 analog front end.

IMAX	: 30 Amps for 6 MΩ Shunt (default)
VMAX	: 471.5 Volts (default)

1.3.2 Formulae for Scaled Parameters

The measurement outputs (and respective alarm thresholds) for the M-API library are stored in a raw format to preserve native resolution of the computed measurements. When using API calls to access or fetch measurement data, the values are automatically scaled and converted according to the data types below.

I_{rms}	= float(Val)* IRMS_MSCALE* IMAX*
V_{rms}	= float(Val)* VRMS _MSCALE* VMAX*
Watts	= float(Val)* POWERSCALE*IMAX*VMAX/1000
Frequency	= integer(Val)/100
Val	: library data (e.g. accessable through SPI read)

When raw measurement data (Val) is directly accessed via the SPI interface, scaling to and from real world or usable values must be done by the host controller using the formulae above.

1.3.3 Example Calculation of Sensor Parameters:

This example demonstrates the calculation of IMAX and VMAX for the default sensor configuration. For more information on sensor selection and configuration, refer to the Hardware Design Guidelines application note.

IMAX Calculation:

IMAX = Imax (pk) / sqrt(2) = Imax (rms)

Max ADC input = 250 mV = IMax (pk) * R shunt

Example:

With a 6 MΩ current shunt, IMax (pk) = 41.7A

=> IMAX = 29.5 Amps.

VMAX Calculation:

VMAX = Vmax (pk) / sqrt(2) = Vmax (rms)

Max ADC input = 250mV = Vmax (pk) * Shunt R / (Series R - Shunt R)

Example:

With a Series R of 2 MΩ and a Shunt R of 750 Ω, VMax (pk) = 666.42 Volts.

=> VMAX = 471.23 Volts

1.4 Reference Documentation

- 78M6618 Data Sheet (v1.3 or later)
- 78M6618 Programmer's Reference Manual
- 78M6618 PDU Evaluation Board User Manual (reference schematics)
- 6618_PDU_S8_URT_V1_00 Firmware Description Document (register descriptions)

2 Firmware Partitions

The 78M6618 firmware provided by Teridian is partitioned into three main components:

- The CE firmware, although a separate set of source code, is the component of the M-API libraries responsible for precision Voltage, Current, Watts, and Narrowband VARs measurements handled by the dedicated Compute Engine. The source code for the CE is not described in this document or made available for user modification.

- The 80515-based M-API firmware, in combination with the CE firmware, completes the M-MAPI library set and provides all the necessary IC configuration, calibration sub-routines, scaling, data conversion, and timing control. This set of libraries is to be linked to the application firmware specific to the desired host interface.

- The Application firmware exercises the M-API library and manages the communication to the host controller/application. Teridian provides an example Serial Driver to be used as sample code as well as the application firmware that uses this Serial Driver and the rest of the M-API library. Refer to the PDU Demo Application document for more information on the application firmware.

Figure 1 shows a high level partitioning of the firmware architecture. The black boxes indicate object code to be provided by Teridian. The white box indicates object <u>and</u> source code provided by Teridian.

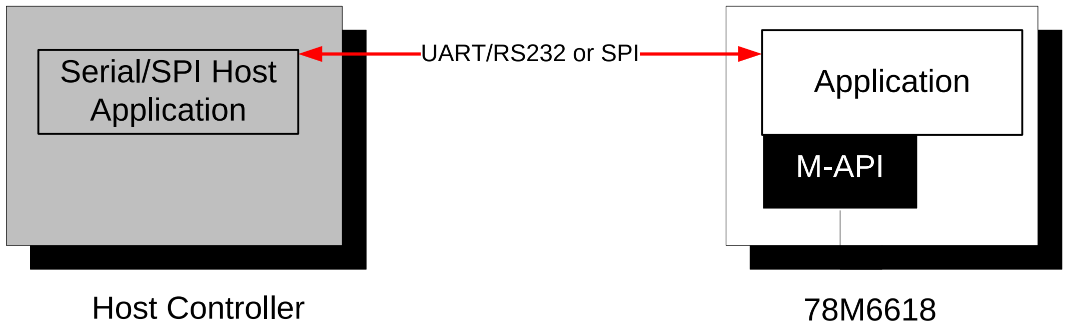


Figure 1: High Level Host/Firmware Interface Architecture

3 Build Environment and Software/Firmware Configuration

The Metrology Application Programming Interface (M-API) is built using Keil Compiler version 8.02, although any Keil version 7.00 or higher is also compatible.

The M-API library is built using specific default configuration as listed in Section 4. Any changes to these default values may require a rebuild of the library.

The M-API library is built with careful consideration of Flash Management and Bank Switching mechanism, the Keil's standard STARTUP.A51 was modified to support the specific Bank Switching; thus it is included in the MAPI library. Bank assignment is defined during linking time; therefore it is not possible to have a single library spreading out into different banks. Thus, the MAPI library was built as 4 separate smaller libraries for the purpose of bank assignments. It is the responsibility of the Application Programmer to make sure the libraries are to be placed at their specific banks for MAPI to work properly. Application code maybe placed anywhere within the 4 banks except at the last 8K of Bank 3 as it is designated for CE usage (see Table 2).

3.1 Program and RAM Memory

The 78M6618 IC has a total of 4K data RAM and 128K bytes of program/Flash memory. The 4K-bytes of data RAM is shared between the CE and the MPU. It is partitioned and reserved for each controller as follows:

Table 1: Data RAM Shared by CE and MPU

Address	Usage
0x0000 – 0x059F	Reserved for CE Data RAM (1.4K).
0x05A0 – 0x0FFF	Reserved for use by MPU (2.6K).

Because the 80515 can only address up to 64 KB of program memory space from 0x0000 to 0xFFFF, the 78M6618 was designed such that access to program memory above 0x7FFF is controlled by the *FL_BANK[1:0]* bits in register (SFR 0xB6). These two bits hold the value of the most significant bits of Flash program address. Flash memory is partitioned as follows:

Table 2: Flash Memory Shared by the CE and MPU Code

Address (hex)	Memory Technology	Memory Type	Name	Typical Usage	Memory Size (bytes)
0x0000 – 0x1DFFF	Flash Memory	Non-volatile	Program memory	MPU Program and non-volatile data	120 KB
0x1E000 – 0x1FFFF	Flash Memory	Non-volatile	Program memory	CE program	8 KB max.

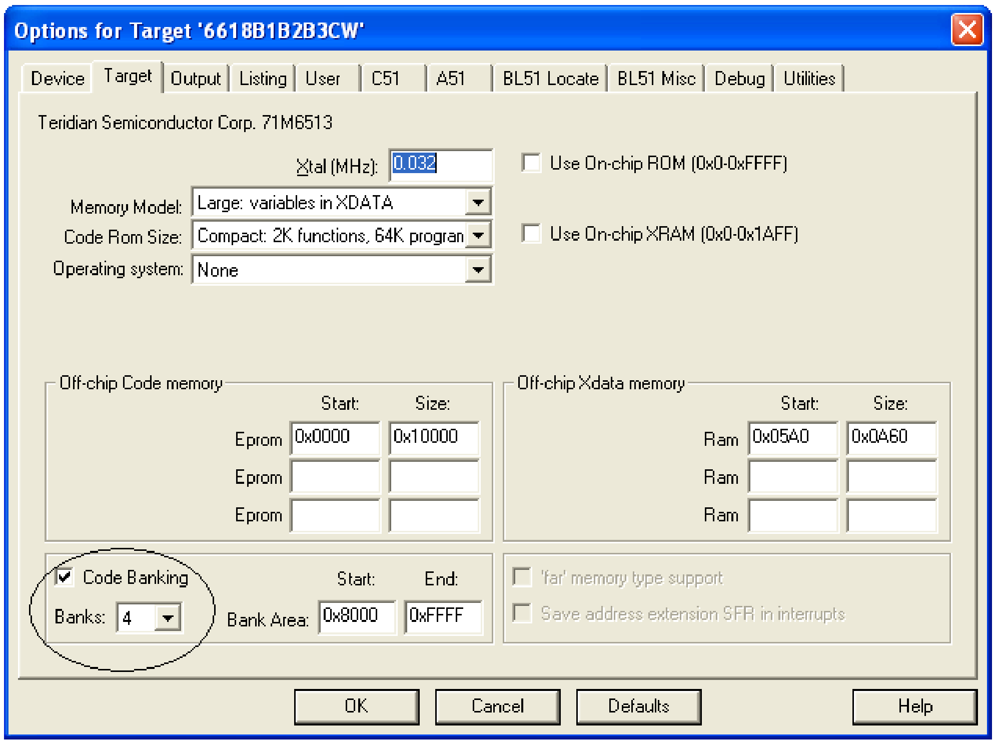
Since the 78M6618 uses different memory banks, access to specific region of Flash requires careful consideration of how the code is spread out. The CE code is currently placed at the highest 8K region of Flash.

3.2 Build Configuration

The accompanying PDU demo application source code has been set up to link to the libraries as described in the following sections.

3.2.1 Bank Assignments

The 78M6618 IC has 4 banks of Flash at 32K each. The banks are divided such as: Common, Bank #1, Bank #2 and Bank #3. The project is setup to identify these banks as shown here:



Options for Target '6618B1B2B3CW'

Device | Target | Output | Listing | User | C51 | A51 | BL51 Locate | BL51 Misc | Debug | Utilities

Teridian Semiconductor Corp. 71M6513

Xtal (MHz): 0.032

☐ Use On-chip ROM (0x0-0xFFFF)

Memory Model: Large: variables in XDATA

Code Rom Size: Compact: 2K functions, 64K progran

☐ Use On-chip XRAM (0x0-0x1AFF)

Operating system: None

Off-chip Code memory

	Start:	Size:
Eprom	0x0000	0x10000
Eprom		
Eprom		

Off-chip Xdata memory

	Start:	Size:
Ram	0x05A0	0x0A60
Ram		
Ram		

☑ Code Banking

Banks: 4

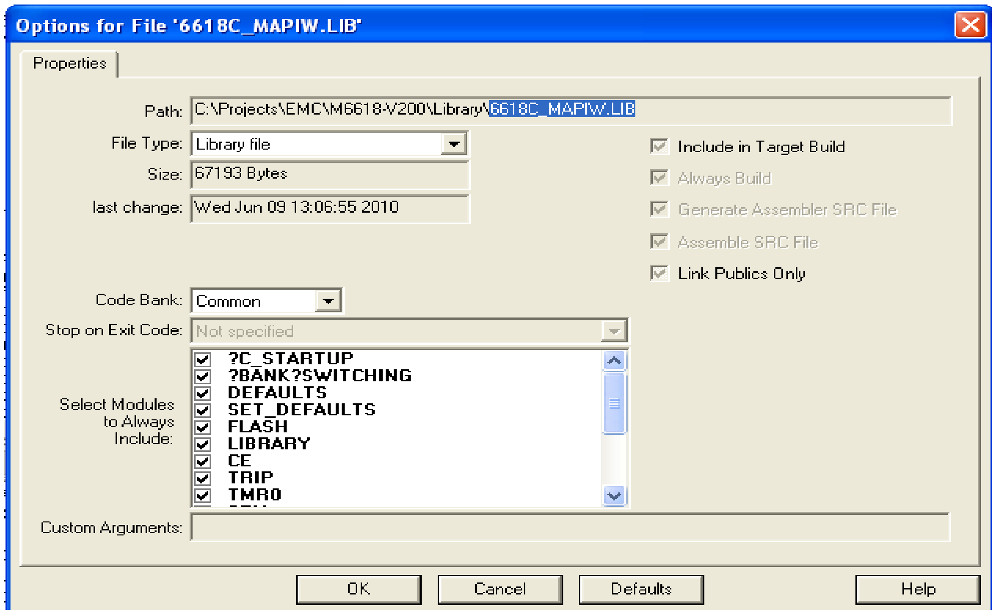
Bank Area: Start: 0x8000 End: 0xFFFF

☐ 'far' memory type support

☐ Save address extension SFR in interrupts

OK | Cancel | Defaults | Help

The common library (6618CMAPIW.LIB) resides in Code Bank 'Common':



Options for File '6618C_MAPIW.LIB'

Properties

Path: C:\Projects\EMC\M6618-V200\Library\6618C_MAPIW.LIB

File Type: Library file

Size: 67193 Bytes

last change: Wed Jun 09 13:06:55 2010

☑ Include in Target Build

☑ Always Build

☑ Generate Assembler SRC File

☑ Assemble SRC File

☑ Link Publics Only

Code Bank: Common

Stop on Exit Code: Not specified

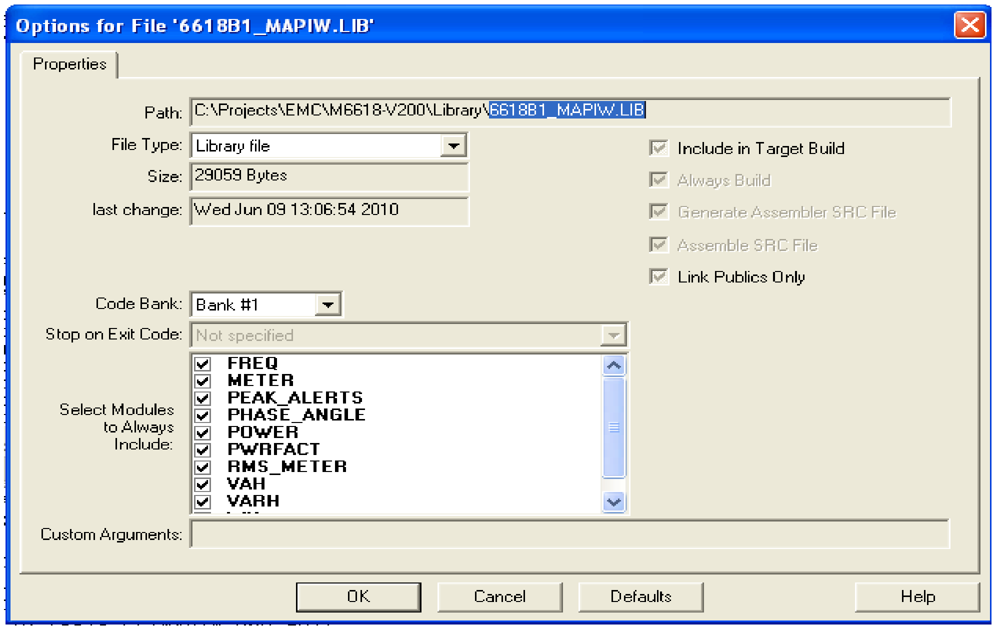
Select Modules to Always Include:

☑ ?C_STARTUP
☑ ?BANK?SWITCHING
☑ DEFAULTS
☑ SET_DEFAULTS
☑ FLASH
☑ LIBRARY
☑ CE
☑ TRIP
☑ TMR0

Custom Arguments:

OK | Cancel | Defaults | Help

The Bank1 library (6618B1_MAPIW.LIB) resides in Code Bank “Bank #1”:


Options for File '6618B1_MAPIW.LIB'

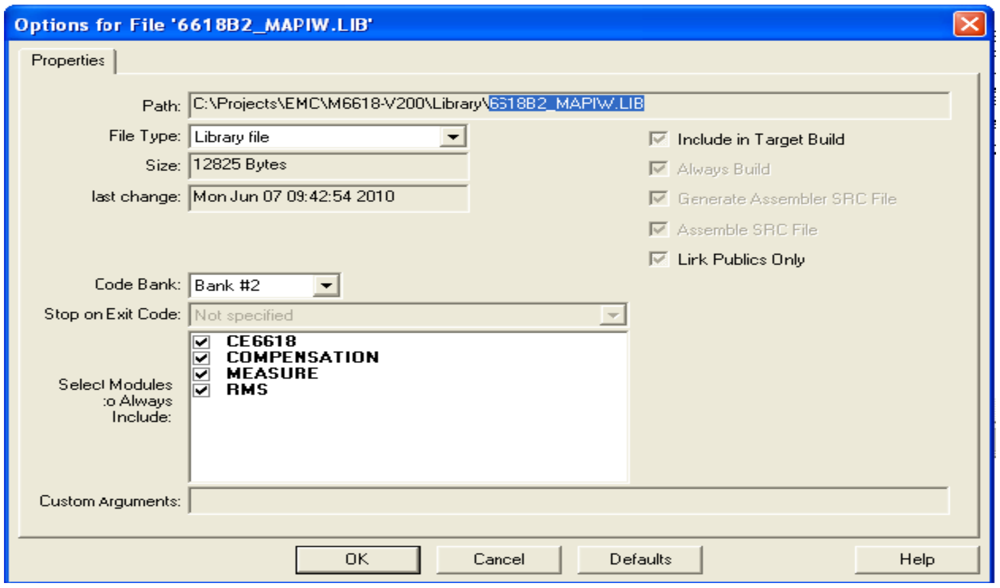
Properties

Path: C:\Projects\EMC\M6618-V200\Library\6618B1_MAPIW.LIB
File Type: Library file
Size: 29059 Bytes
last change: Wed Jun 09 13:06:54 2010
Code Bank: Bank #1
Stop on Exit Code: Not specified
Select Modules to Always Include:
- [✓] FREQ
- [✓] METER
- [✓] PEAK_ALERTS
- [✓] PHASE_ANGLE
- [✓] POWER
- [✓] PWRFACT
- [✓] RMS_METER
- [✓] VAH
- [✓] VARH

Custom Arguments:

- [✓] Include in Target Build
- [✓] Always Build
- [✓] Generate Assembler SRC File
- [✓] Assemble SRC File
- [✓] Link Publics Only

The Bank 2 library (6618B2_MAPIW.LIB) resides in Code Bank “Bank #2”:


Options for File '6618B2_MAPIW.LIB'

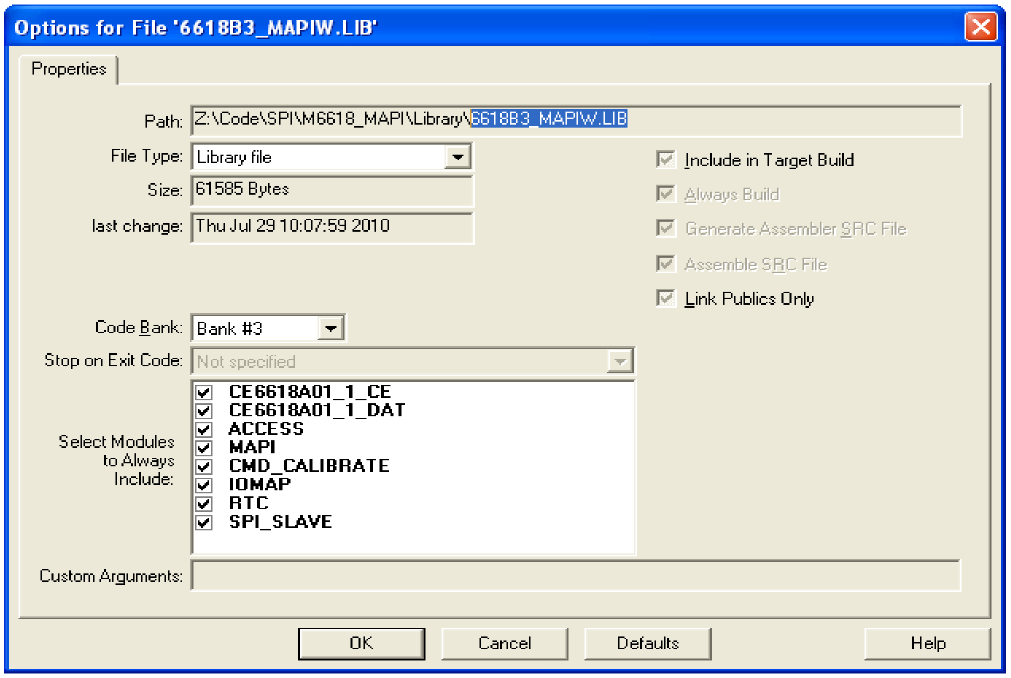
Properties

Path: C:\Projects\EMC\M6618-V200\Library\6618B2_MAPIW.LIB
File Type: Library file
Size: 12825 Bytes
last change: Mon Jun 07 09:42:54 2010
Code Bank: Bank #2
Stop on Exit Code: Not specified
Select Modules to Always Include:
- [✓] CE6618
- [✓] COMPENSATION
- [✓] MEASURE
- [✓] RMS

Custom Arguments:

- [✓] Include in Target Build
- [✓] Always Build
- [✓] Generate Assembler SRC File
- [✓] Assemble SRC File
- [✓] Link Publics Only

The Bank 3 library (6618B3_MAPIW.LIB) resides in Code Bank “Bank #3”:


Options for File '6618B3_MAPIW.LIB'

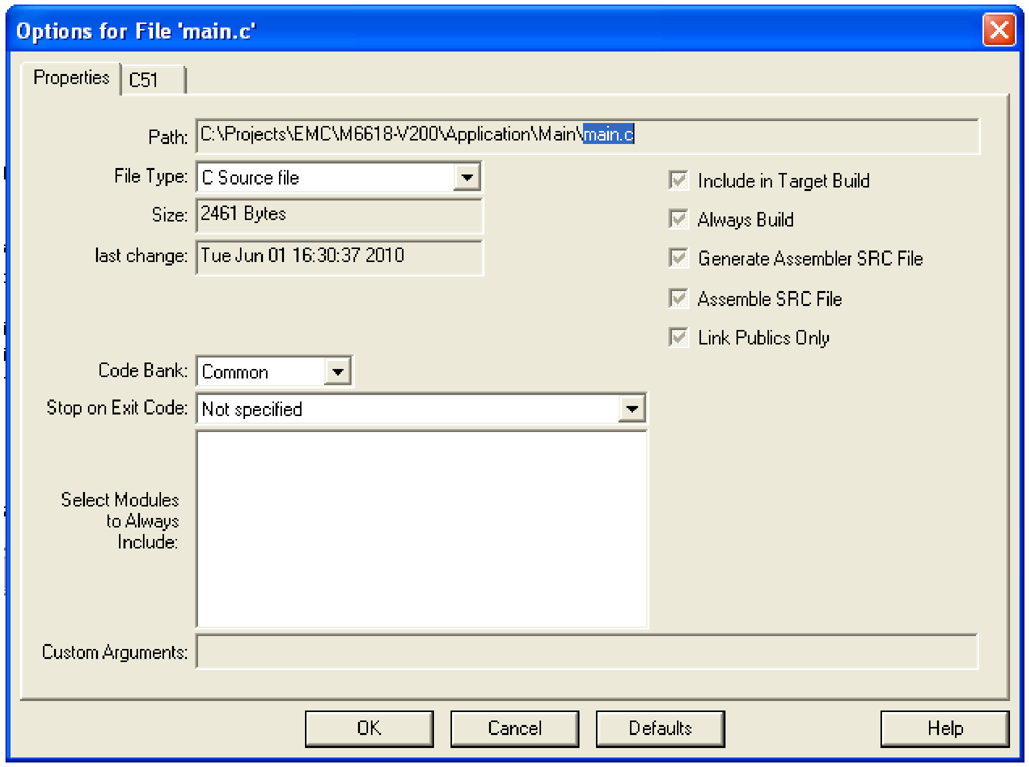
Properties

Path: Z:\Code\SPI\M6618_MAPI\Library\6618B3_MAPIW.LIB
File Type: Library file
Size: 61585 Bytes
last change: Thu Jul 29 10:07:59 2010
Code Bank: Bank #3
Stop on Exit Code: Not specified
Select Modules to Always Include:
- ✓ CE6618A01_1_CE
- ✓ CE6618A01_1_DAT
- ✓ ACCESS
- ✓ MAPI
- ✓ CMD_CALIBRATE
- ✓ IOMAP
- ✓ RTC
- ✓ SPI_SLAVE

Custom Arguments:

- ✓ Include in Target Build
- ✓ Always Build
- ✓ Generate Assembler SRC File
- ✓ Assemble SRC File
- ✓ Link Publics Only

In addition to bank assignment to the libraries, the application code is also assigned to specific banks as follows with main.c resides in the common code bank and the rest of the application source reside in Bank #3 as shown below:

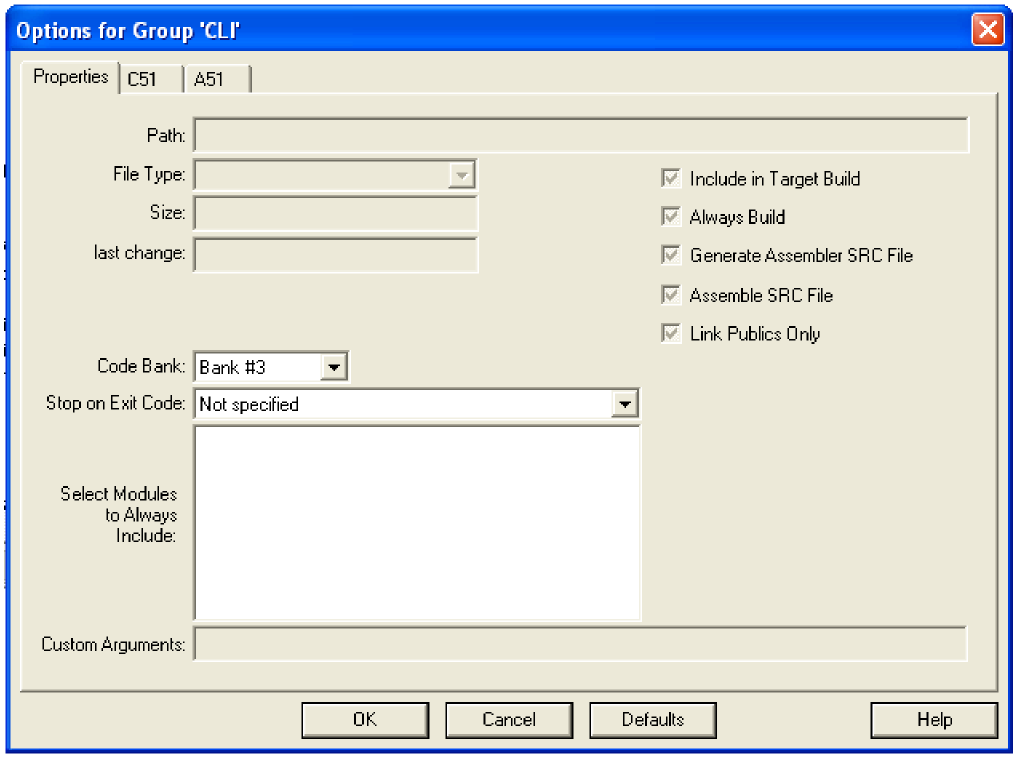

Options for File 'main.c'

Properties | C51

Path: C:\Projects\EMC\M6618-V200\Application\Main\main.c
File Type: C Source file
Size: 2461 Bytes
last change: Tue Jun 01 16:30:37 2010
Code Bank: Common
Stop on Exit Code: Not specified
Select Modules to Always Include:
Custom Arguments:

- ✓ Include in Target Build
- ✓ Always Build
- ✓ Generate Assembler SRC File
- ✓ Assemble SRC File
- ✓ Link Publics Only

The whole 'CLI' group of files is assigned to Bank #3 as shown below.



Code Bank: Bank #3

Stop on Exit Code: Not specified

☑ Include in Target Build

☑ Always Build

☑ Generate Assembler SRC File

☑ Assemble SRC File

☑ Link Publics Only

Note: To find out which file resides in which bank, it is best to look at Keil's Mapped file (*.M51 file where * is the object code name). In the example application, the top part of the 6618_CLIMAPIWv2_00.M51, the following is shown (bank number is highlighted and reformatting of the text was done for easy reading):

BL51 BANKED LINKER/LOCATER V6.22, INVOKED BY:

C:\KEIL\C51\BIN\BL51.EXE

//Application files' bank assignment:

COMMON {main.obj},
BANK3 {io.obj},
BANK3 {cli.obj},
BANK3 {cmd_misc.obj},
BANK3 {menu.obj},
BANK3 {cmd_sfr.obj},
BANK3 {cmd_MAPI.obj},
BANK3 {cmd_ce.obj},
BANK3 {cmd_IOMap.obj},
BANK3 {c_serial.obj},

//Library files' bank assignment:

COMMON {..\Library\6618C_MAPIW.LIB (?C_STARTUP, ?BANK?SWITCHING, DEFAULTS, SET_DEFAULTS, FLASH, LIBRARY, CE, TRIP, TMR0, STM, TSC, IO6618, IRQ, MATH, SFRS, SER0CLI)},
BANK1 {..\Library\6618B1_MAPIW.LIB (FREQ, METER, PEAK_ALERTS, PHASE_ANGLE, POWER, PWRFACT, RMS_METER, VAH, VARH, WH)},
BANK2 {..\Library\6618B2_MAPIW.LIB (CE6618, COMPENSATION, MEASURE, RMS)},
BANK3 {..\Library\6618B3_MAPIW.LIB (CE6618A01_1_CE, CE6618A01_1_DAT, ACCESS, MAPI, CMD_CALIBRATE, IOMAP, RTC, SPI_SLAVE)}

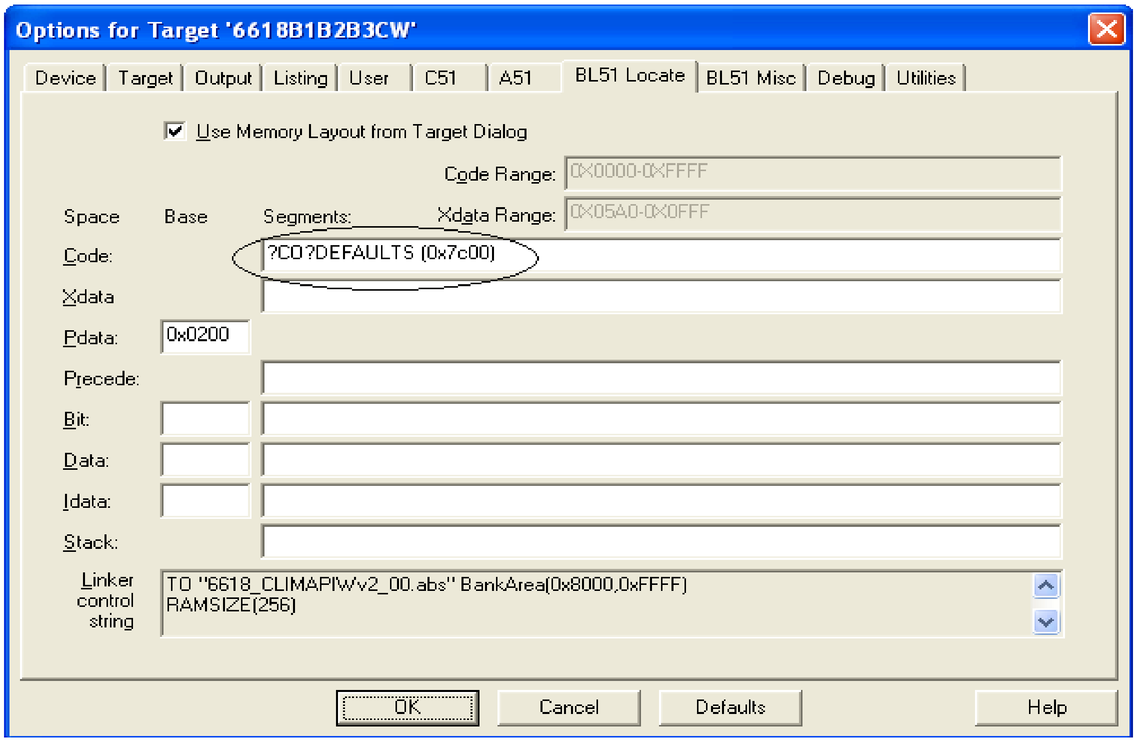
TO 6618_CLIMAPIWv2_00.abs

3.2.2 Flash/Code Space Assignment

In addition to bank assignments, there are three files that are part of the Bank 3 library (6618B3_MAPIW.LIB) that are assigned to a very specific area of Flash within Bank 3. The Flash/Code space assignment is necessary in order to keep the images of the CE code, CE data and Energy Measurement Constant isolated. These assignments are: CE data image is to reside at starting address: 0xDFFE; the CE code image is to reside at starting address: 0xEFFE; and the constants defined in a file called Defaults to reside at starting address: 0x7C00. This information is presented in the M51 file as follows:

BANKAREA (0X8000, 0XFFFF) RAMSIZE (256) DISABLEWARNING (6) BANK3 (?CO?**CE6618A01_1_DAT** (**0XDFFE**), ?CO? **CE6618A01_1_CE** (**0XEFFE**)) CODE (0X0000-0XFFFF, ?CO?**DEFAULTS** (**0X7C00**)) XDATA (0X05A0-0X0FFF) PDATA (0X0200).

And the setup for these files is shown below for defaults:



[✓] Use Memory Layout from Target Dialog

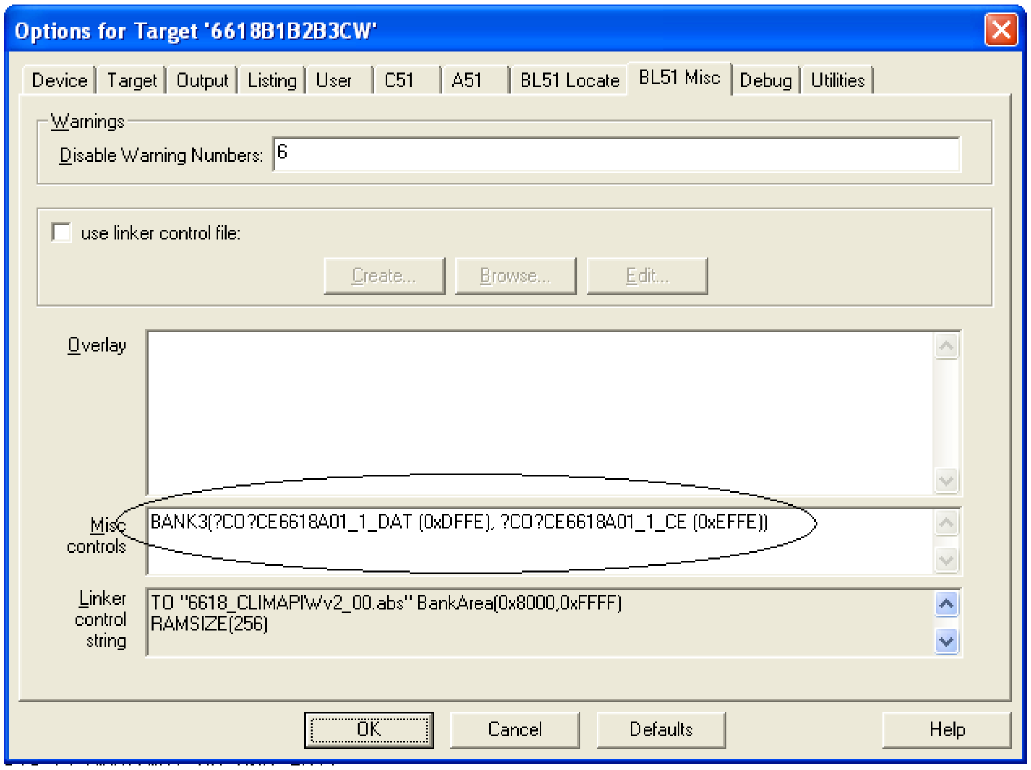
Code Range: 0X0000-0XFFFF

Xdata Range: 0X05A0-0X0FFF

Space	Base	Segments:
Code:		?CO?DEFAULTS (0x7c00)
Xdata		
Pdata:	0x0200	
Precede:		
Bit:		
Data:		
Idata:		
Stack:		

Linker control string: TO "6618_CLIMAPIWv2_00.abs" BankArea(0x8000,0xFFFF) RAMSIZE(256)

And for CE code and data images:



Options for Target '6618B1B2B3CW'
Device | Target | Output | Listing | User | C51 | A51 | BL51 Locate | BL51 Misc | Debug | Utilities
Create... Browse... Edit...
OK Cancel Defaults Help

Warnings

Disable Warning Numbers: 6

☐ use linker control file:

Overlay

Misc controls: BANK3(?CO?CE6618A01_1_DAT (0xDFFE), ?CO?CE6618A01_1_CE (0xEFFE))

Linker control string: TO "6618_CLIMAPIWv2_00.abs" BankArea(0x8000,0xFFFF) RAMSIZE(256)

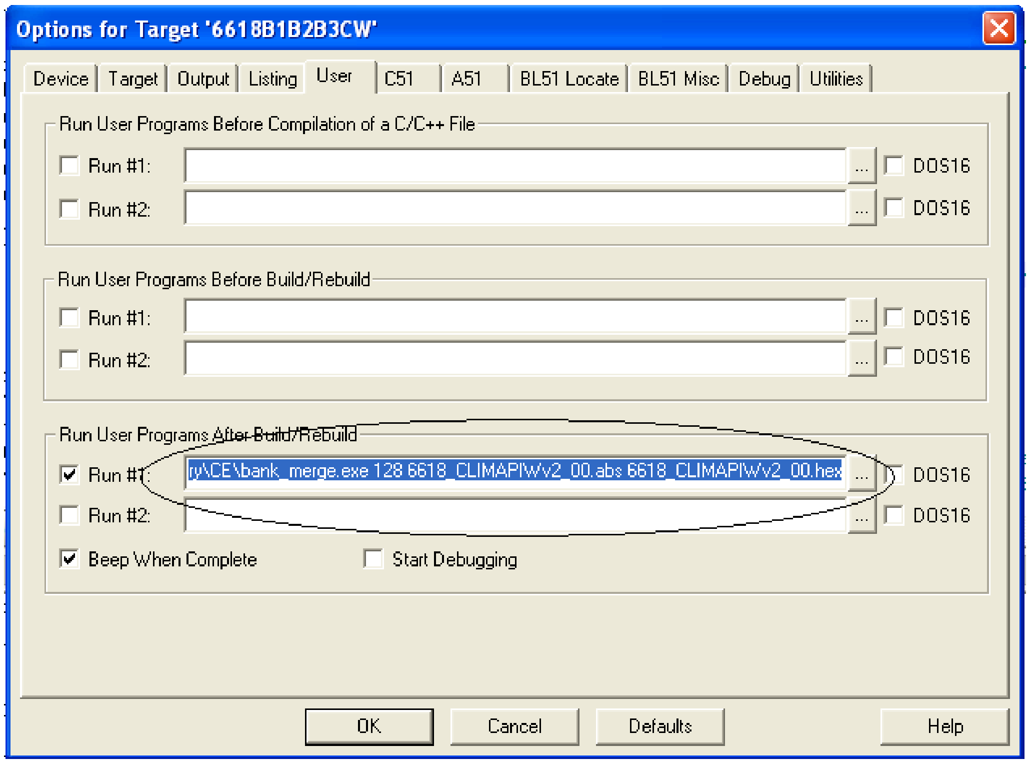
3.2.3 Flash/Code and Bank Switch: Putting It All Together

The Keil compiler does not produce a single nicely organized and contiguous object code/hex file when it comes to bank assignments; instead, it produces an individual hex file for each bank. So when downloading the code to Flash after successfully compiling and linking with Keil, the user will need to manually select and program each corresponding hex file into its bank. For example, the attached CLI application code after compiling and linking using the Keil compiler will result in three separate hex files: 6618_CLIMAPIWv2_00.abs.H01, 6618_CLIMAPIWv2_00.abs.H02 and 6618_CLIMAPIWv2_00.abs.H03.

Teridian has simplified the Flash programming process by providing the user with a Bank_Merge.exe application (a Dos base program), which resides in the '.\library' folder of the attached zipped file. The Bank_Merge.exe will take in all the three hex files, as described above, and merge them into one single contiguous hex file that can be downloaded using the Signum ICE debugger or the Teridian's TFP2 flash programmer's tool. At the DOS prompt, type in: "bank_merge /?" will display its usage as follows:

```
 Usage: bank_merge <ROM Size> <Input Name> <Output>
    <ROM Size> - The memory size of ROM in kbyte (64,128,192,256)
    <Input>    - Compiled bank hex files' name without extension
    <Output>   - Output file name. MUST have '.hex' extension
```

Example, as shown below: bank_merge.exe 128 6618_CLIMAPIWv2_00.abs 6618_CLIMAPIV2_00.hex
This example merges the three (3) Keil compiled hex files '6618_CLIMAPIWv2_00.abs.H01', '6618_CLIMAPIWv2_00.abs.H02' and '6618_CLIMAPIWv2_00.abs.H03' and generates a single hex file '6618_CLIMAPIWv2_00.hex' with a memory size of 128kbyte.



Run User Programs Before Compilation of a C/C++ File
- [ ] Run #1: — [ ] DOS16
- [ ] Run #2: — [ ] DOS16

Run User Programs Before Build/Rebuild
- [ ] Run #1: — [ ] DOS16
- [ ] Run #2: — [ ] DOS16

Run User Programs After Build/Rebuild
- [✓] Run #1: rv\CE\bank_merge.exe 128 6618_CLIMAPIWv2_00.abs 6618_CLIMAPIWv2_00.hex — [ ] DOS16
- [ ] Run #2: — [ ] DOS16
- [✓] Beep When Complete
- [ ] Start Debugging

4 M-API Libraries

The libraries are designed and partitioned to be placed at specific banks as follows:

Library Name	Flash Bank	Approx. Size	Purpose
Wide **B**and Option			
6618**C**_MAPI**W**.LIB	**C**ommon	19K	Keeps all common (frequently called) code. Includes (but not limited to): Interrupt service routines, timer APIs, Relay APIs, Serial 0 APIs, Flash management, access to all metering registers.
6618**B1**_MAPI**W**.LIB	**B**ank **1**	6K	Reserved for metering calculations.
6618**B2**_MAPI**W**.LIB	**B**ank **2**	0.5K	More metering calculations.
6618**B3**_MAPI**W**.LIB	**B**ank **3**	9K + 4K	The first/lower address of 9K is used mostly for calibration, accessing registers and the actual library API calls. The bottom/higher address of 4K is used up by CE. The current CLI and M commands code is also residing here, which takes up another 9K.
***N**arrow **B**and Option			
6618**C**_MAPI**N**.LIB	**C**ommon	19K	Keeps all common (frequently called) code. Includes (but not limited to): Interrupt service routines, timer APIs, Relay APIs, Serial 0 APIs, Flash management, access to all metering registers.
6618**B1**_MAPI**N**.LIB	**B**ank **1**	6K	Reserved for metering calculations.
6618**B2**_MAPI**N**.LIB	**B**ank **2**	0.5K	More metering calculations.
6618**B3**_MAPI**N**.LIB	**B**ank **3**	9K + 4K	The first/lower address of 9K is used mostly for calibration, accessing registers and the actual library API calls. The bottom/higher address of 4K is used up by CE. The current CLI and M commands code is also residing here, which takes up another 9K.

* Narrow-Band libraries are not fully tested and will be released in the near future.

4.1 Library Initialization and Operation

4.1.1 MAPI_Init()

Purpose	Initialize all critical variables, start the Compute Engine (CE) and its interrupts, start the MPU timer, setup all default values. The application must first call this API before any attempt to use other APIs.
Synopsis	`Void MAPI_Init(  void );`
Parameters	None.
Return Codes	None.

4.1.2 MAPI_SelectMeter() – *future feature*

Purpose	The accumulation interval is obtained by setting specific values in the PRE_SAMPS, SUM_CYCLES, FIR_LEN, MUX_DIV registers along with specific selectable CE Clock rates. At present time, this API library is using a default configuration with FIR_LEN at its highest/fastest rate, FIR=0/138 CK32/CE cycles. The default value is PRE_SAMPS = 50 and SUM_CYCLES = 60 with MUX_DIV = 10. This constitutes an accumulation interval of approximately 1 second. In future releases, this API may be used to select a different accumulation interval based on a chosen time interval such as: 250ms, 500ms, or 1 second.

Synopsis	`Bool  MAPI_SelectMeter ( enum eAccInterval TimeInterval );`
	`Enum eAccInterval { _250ms, _500ms, _1sec, _2sec);`

Parameters	`TimeInterval` Input parameter.
Return Codes	TRUE (1) – Successful operation. FALSE(0) – Failed operation. Default values are used, which is 1 second accumulation interval.

4.1.3 MAPI_MeterRun()

Purpose	Run this function in foreground mode to reset the watchdog, update all measurement outputs, and compare data to Min/Max thresholds. Once `MAPI_Init` is called, the CE will update all atomic measurements every accumulation interval. It is the task of the application to put this API into its main loop so that it can post-process the data just imported from the CE. If this API is called more than once within the same accumulation interval, no changes will be updated and a FALSE will be returned. Typically, the application layer will then call `MAPI_MeterStatus()` to check for any alarm conditions and call `MAPI_GetSetRegister()`to get updated measurement data.
Synopsis	`Bool  MAPI_MeterRun ( void );`
Parameters	None.
Return Codes	TRUE (1) – New data has been updated. FALSE(0) – No change from the last update run.

4.1.4 MAPI_MeterStatus()

Purpose

Run this function periodically to detect any error/warning. Any non-zero value returned indicates some failure/warning has occurred. MPU Output Threshold levels and mask settings for the alarms can be read, modified, and saved using the MAPI_GetSetRegister() API call.

Note: Registers 02,03,102,103 also contain meter status for direct access via SPI interface.

Synopsis

```
void   MAPI_MeterStatus ( unsigned long Common_Status,
                          unsigned long WB_Status,
                          unsigned long NB_Status );
```

Parameters

`Common_Status` Output parameter.

A 32-bit word status that indicates statuses as follows:

Min Temperature exceeded	Bit 0 = 1 //0000 0001
Max Temperature exceeded	Bit 1 = 1 //0000 0002
Min Frequency exceeded	Bit 2 = 1 //0000 0004
Max Frequency exceeded	Bit 3 = 1 //0000 0008
SAG A detected	Bit 4 = 1 //0000 0010
Under Min VA on A	Bit 5 = 1 //0000 0020
Over Max Voltage on A	Bit 6 = 1 //0000 0040
SAG B detected	Bit 7 = 1 //0000 0080
Under Min VB on B	Bit 8 = 1 //0000 0100
Over max Voltage on B	Bit 9 = 1 //0000 0200
Line/Neutral Reversal	Bit 10 = 1 //0000 0400
Creep on IA	Bit 16 = 1 //0001 0000
Creep on IB	Bit 17 = 1 //0002 0000
Creep on IC	Bit 18 = 1 //0004 0000
Creep on ID	Bit 19 = 1 //0008 0000
Creep on IE	Bit 20 = 1 //0010 0000
Creep on IF	Bit 21 = 1 //0020 0000
Creep on IG	Bit 22 = 1 //0040 0000
Creep on IH	Bit 23 = 1 //0080 0000

`WB_Status` Output Parameter

A 32-bit word status that indicates status of wide band measurements as follows:

Over max current on Outlet 1	Bit 0 = 1 //0000 0001
Min Power Factor exceeded on Outlet 1	Bit 1 = 1 //0000 0002
Max Power Factor exceeded on Outlet 1	Bit 2 = 1 //0000 0004
Over max current on Outlet 2	Bit 3 = 1 //0000 0008
Min Power Factor exceeded on Outlet 2	Bit 4 = 1 //0000 0010
Max Power Factor exceeded on Outlet 2	Bit 5 = 1 //0000 0020
Over max current on Outlet 3	Bit 6 = 1 //0000 0040
Min Power Factor exceeded on Outlet 3	Bit 7 = 1 //0000 0080
Max Power Factor exceeded on Outlet 3	Bit 8 = 1 //0000 0100
Over max current on Outlet 4	Bit 9 = 1 //0000 0200
Min Power Factor exceeded on Outlet 4	Bit 10 = 1 //0000 0400
Max Power Factor exceeded on Outlet 4	Bit 11 = 1 //0000 0800
Over max current on Outlet 5	Bit 12 = 1 //0000 1000
Min Power Factor exceeded on Outlet 5	Bit 13 = 1 //0000 2000
Max Power Factor exceeded on Outlet 5	Bit 14 = 1 //0000 4000
Over max current on Outlet 6	Bit 15 = 1 //0000 8000
Min Power Factor exceeded on Outlet 6	Bit 16 = 1 //0001 0000
Max Power Factor exceeded on Outlet 6	Bit 17 = 1 //0002 0000
Over max current on Outlet 7	Bit 18 = 1 //0004 0000
Min Power Factor exceeded on Outlet 7	Bit 19 = 1 //0008 0000
Max Power Factor exceeded on Outlet 7	Bit 20 = 1 //0010 0000
Over max current on Outlet 8	Bit 21 = 1 //0020 0000
Min Power Factor exceeded on Outlet 8	Bit 22 = 1 //0040 0000
Max Power Factor exceeded on Outlet 8	Bit 23 = 1 //0080 0000
Over Max Current Total	Bit 24 = 1 //0100 0000
Reserved	Bits 25:31

`NB_Status` Output Parameter.

A 32-bit word status that indicates status of narrow band measurements as follows:

Over max NB current on A	Bit 0 = 1 //0000 0001
Min Power Factor exceeded on A	Bit 1 = 1 //0000 0002
Max Power Factor exceeded on A	Bit 2 = 1 //0000 0004
Over max NB current on B	Bit 3 = 1 //0000 0008
Min Power Factor exceeded on B	Bit 4 = 1 //0000 0010
Max Power Factor exceeded on B	Bit 5 = 1 //0000 0020
Over max NB current on C	Bit 6 = 1 //0000 0040
Min Power Factor exceeded on C	Bit 7 = 1 //0000 0080
Max Power Factor exceeded on C	Bit 8 = 1 //0000 0100
Over max NB current on D	Bit 9 = 1 //0000 0200
Min Power Factor exceeded on D	Bit 10 = 1 //0000 0400
Max Power Factor exceeded on D	Bit 11 = 1 //0000 0800
Over max NB current on E	Bit 12 = 1 //0000 1000
Min Power Factor exceeded on E	Bit 13 = 1 //0000 2000
Max Power Factor exceeded on E	Bit 14 = 1 //0000 4000
Over max NB current on F	Bit 15 = 1 //0000 8000
Min Power Factor exceeded on F	Bit 16 = 1 //0001 0000
Max Power Factor exceeded on F	Bit 17 = 1 //0002 0000
Over max NB current on G	Bit 18 = 1 //0004 0000
Min Power Factor exceeded on G	Bit 19 = 1 //0008 0000
Max Power Factor exceeded on G	Bit 20 = 1 //0010 0000
Over max NB current on H	Bit 21 = 1 //0020 0000
Min Power Factor exceeded on H	Bit 22 = 1 //0040 0000
Max Power Factor exceeded on H	Bit 23 = 1 //0080 0000
Over max NB Current Total	Bit 24 = 1 //0100 0000

Return Codes None.

4.2 Library Inputs and Outputs

4.2.1 MAPI_GetSetRegister()

Purpose

Get or Set the value of a specific register location. An error will be returned if the address is out of range or within the restricted location. Care must be taken when calling this API to Set the value into a register. A call to `MAPI_UpdateCE()` and/or `MAPI_UpdateMPU()` will be necessary if it shall be permanently saved into Flash. There are three types of registers: MPU, CE and I/O Hardware Control. The range of address indicates the type of registers as follows:

0x0000 – 0x03FF: MPU Address. Can also be accessed via SPI interface.
0x0400 – 0x07FF: CE Address. No direct access via SPI interface.
0x2000 – 0x20FF: Hardware I/O Control Address. No direct access via SPI.

When calling this function, make sure the documented Reg.Address is or'ed with the specific type of register (CE or MPU or I/O RAM) defined such as:

```
enum REG_TYPE {
      MPU_ADDRESS  = 0x0000,
      CE_ADDRESS   = 0x0800,
      RI_ADDRESS   = 0x2000};
```

Synopsis

`enum MAPI_RC MAPI_GetSetRegister( bool Operation, struct _Reg_t *Reg)`

Where `_Reg_t` is defined as:

```
Struct _Reg_t
{
   Unsigned Integer       Address;
   Unsigned Long          Value;
   Unsigned Char          TypeSize;
   Unsigned Integer       ScaleFactor;
};
```

Parameters	`Operation`	Input parameter. TRUE(1) – Set Operation, FALSE(0) – Get Operation.
	`Struct _Reg_t`	When `Operation`=TRUE, Output parameter. When `Operation`=FALSE, Input parameter.
	`Address`	Two-byte address location. Address where its content will be extracted (`Operation`=FALSE) or stored (`Operation` = TRUE). Note,
	`Value`	Four-byte value to be stored or retrieved. Content from Address to be extracted (*Operation*=FALSE) or stored (`Operation` = TRUE).
	`TypeSize`	Type and Size of register's content. This byte is defined as follows:

Bit 8	Bit 7…4	Bit 3…1
<u>SIGNED</u>: Register value is a signed value (1-negative, 0-positive).	**<u>TYPE</u>**: Register value is one of the following types: INTEGER – 0x00 CONFIG – 0x70 FLOAT – 0x10 POWER – 0x18 IRMS_T – 0x20 ENERGY – 0x28 VRMS_T – 0x30 FREQ – 0x38 IRMS_M – 0x40 COUNT – 0x48 VRMS_M – 0x50 TIMER – 0x58 CONTROL – 0x60	**<u>SIZE</u>**: Indicates storage size (in bytes) of register where: 1 – char, 1-byte 2 - Integer , 2-byte 4 - Word, 4-byte
Typically used for power factor, phase adjust.	Used by API call to determine formulae for data scaling and conversion	

`ScaleFactor`	Output parameter. This byte indicates presentation format of the register content defined as follows: 10 – Tenth unit factor. 100 – Hundredth unit factor. 1000 – Thousandth unit factor.

Return Codes	MAPI_OK – successful operation. MAPI_RESTRICTED – specified address is restricted.

4.2.1.1 Auto-Scaling

When retrieving measurement data using the MAPI_GetSetRegister() call, the returned data value is automatically converted to usable data according to the TypeSize of the register location. The predefined TypeSize and ScaleFactor are also returned.

When writing alarm thresholds to library input registers, usable data values are automatically converted to raw values according to the TypeSize of the target register address. TypeSize and ScaleFactor are predefined and non-changeable.

Example:

- When getting or retrieving V_{RMS} data, the returned value is in mV_{RMS} (120000 mV_{RMS})
- When setting a V_{RMS} alarm threshold, the value is entered in V_{RMS} (120.000 V_{RMS})

4.2.1.2 Output Data Address Locations

The following output data is updated once per accumulation interval and available directly via the SPI interface or via API calls. With the current M-API architecture, only one bandwidth data type (narrowband or wideband) can be used in each library build.

MPU ADDRESS		***NAME***	***LSB***	***TYPE***	**DESCRIPTION**
WB	***NB***				
00	100	Delta Temperature	0.1 °C	FLOAT	Temperature difference from 22 °C.
01	101	Line Frequency	0.01 Hz	FREQ	Line Frequency.
02	102	Alarm Status (common)			Bit 0 – MIN Temperature Alarm. Bit 1 – MAX Temperature Alarm. Bit 2 – MIN Frequency Alarm. Bit 3 – MAX Frequency Alarm. Bit 4 – SAG Voltage Alarm for VA. Bit 5 – MIN Voltage Alarm for VA. Bit 6 – MAX Voltage Alarm for VA. Bit 7 – SAG Voltage Alarm for VB. Bit 8 – MIN Voltage Alarm for VB. Bit 9 – MAX Voltage Alarm for VB. Bit 10 – Line/Neutral Reversal Detected Bits 11:15 – Unused. Bit 16 – Creep Alert for Outlet 1 (IA). Bit 17 – Creep Alert for Outlet 2 (IB). Bit 18 – Creep Alert for Outlet 3 (IC). Bit 19 – Creep Alert for Outlet 4 (ID). Bit 20 – Creep Alert for Outlet 5 (IE). Bit 21 – Creep Alert for Outlet 6 (IF). Bit 22 – Creep Alert for Outlet 7 (IG). Bit 23 – Creep Alert for Outlet 8 (IH). Bits 24:31 – Reserved.

MPU ADDRESS		***NAME***	***LSB***	***TYPE***	***DESCRIPTION***
WB	***NB***				
03	103	Alarm Status (outlet specific)			Bit 0 – MAX Current Alarm – Outlet1 Bit 1 – MIN Power Factor Alarm– Outlet1 Bit 2 – MAX Power Factor Alarm– Outlet1 Bit 3 – MAX Current Alarm – Outlet2 Bit 4 – MIN Power Factor Alarm– Outlet2 Bit 5 – MAX Power Factor Alarm– Outlet2 Bit 6 – MAX Current Alarm – Outlet3 Bit 7 – MIN Power Factor Alarm– Outlet3 Bit 8 – MAX Power Factor Alarm– Outlet3 Bit 9 – MAX Current Alarm – Outlet4 Bit 10 – MIN Power Factor Alarm– Outlet4 Bit 11 – MAX Power Factor Alarm– Outlet4 Bit 12 – MAX Current Alarm – Outlet5 Bit 13 – MIN Power Factor Alarm– Outlet5 Bit 14 – MAX Power Factor Alarm– Outlet5 Bit 15 – MAX Current Alarm – Outlet6 Bit 16 – MIN Power Factor Alarm– Outlet6 Bit 17 – MAX Power Factor Alarm– Outlet6 Bit 18 – MAX Current Alarm – Outlet7 Bit 19 – MIN Power Factor Alarm– Outlet7 Bit 20 – MAX Power Factor Alarm– Outlet7 Bit 21 – MAX Current Alarm – Outlet8 Bit 22 – MIN Power Factor Alarm– Outlet8 Bit 23 – MAX Power Factor Alarm– Outlet8 Bit 24 – MAX Total Current Bits 25:31 – Reserved.
04	104	Over Current Event Count	1	INTEGER	Number of accumulation intervals where value exceeded alarm threshold
05	105	Under Voltage Event Count	1	INTEGER	Number of accumulation intervals where value exceeded alarm threshold
06	106	Over Voltage Event Count	1	INTEGER	Number of accumulation intervals where value exceeded alarm threshold
07	107	Volts	mVrms	VRMS_T	AC Line Voltage (RMS)

MPU ADDRESS								***NAME***	***LSB***	***TYPE***	***DESCRIPTION***
Outlet 1		**Outlet 2**		**Outlet 3**		**Outlet 4**					
WB	***NB***	***WB***	***NB***	***WB***	***NB***	***WB***	***NB***				
08	108	10	110	18	118	20	120	Active Power	mW	POWER	Active Power (per accum interval).
09	109	11	111	19	119	21	121	Energy	mWh	ENERGY	Accumulated Energy
0A	10A	12	112	1A	11A	22	122	Cost	mUnits	FLOAT	Accumulated Cost
0B	10B	13	113	1B	11B	23	123	Current	mArms	IRMS_T	RMS Current.
0C	10C	14	114	1C	11C	24	124	Reactive Power	mW	POWER	Reactive Power (per accum interval).
0D	10D	15	115	1D	11D	25	125	Apparent Power	mW	POWER	Apparent Power (per accum interval).
0E	10E	16	116	1E	11E	26	126	Power Factor	–	FLOAT	Power factor. (output will be between -1.00 and 1.00)
0F	10F	17	117	1F	11F	27	127	Phase Angle	–	FLOAT	Phase angle. (output will be between 180.000 and -180.000)

MPU ADDRESS										***NAME***
Outlet 5		**Outlet 6**		**Outlet 7**		**Outlet 8**		***Outlet Total***		
WB	***NB***	***WB***	***NB***	***WB***	***NB***	***WB***	***NB***	***WB***	***NB***	
28	128	30	130	38	138	40	140	48	148	Active Power
29	129	31	131	39	139	41	141	49	149	Energy
2A	12A	32	132	3A	13A	42	142	4A	14A	Cost
2B	12B	33	133	3B	13B	43	143	4B	14B	Current
2C	12C	34	134	3C	13C	44	144	4C	14C	Reactive Power
2D	12D	35	135	3D	13D	45	145	4D	14D	Apparent Power
2E	12E	36	136	3E	13E	46	146	-	-	Power Factor
2F	12F	37	137	3F	13F	47	147	-	-	Phase Angle

4.2.1.3 MPU Library Inputs

The following inputs can be modified (and saved to Flash) using API calls. For more information on register descriptions, refer to the 6618_PDU_S8_URT_V1_00 Firmware Description Document.

Category	***Name***	***MPU Address***		***Description***
Common Alarm Threshold	Temperature	240 241		Min Temperature Alarm Threshold Max Temperature Alarm Threshold
	Frequency	242 243		Min Frequency Alarm Threshold Max Frequency Alarm Threshold
	Voltage (A) Voltage (B)	244 245 246 247 248 249		SAG (A) Voltage Alarm Threshold Min Voltage (A) Alarm Threshold Max Voltage (A) Alarm Threshold SAG (B) Voltage Alarm Threshold Min Voltage (B) Alarm Threshold Max Voltage (B) Alarm Threshold
Outlet Specific Alarm Thresholds		*WB*	*NB*	
	Current - Outlet 1	250	269	Max Current Alarm Threshold
	Power Factor - Outlet 1	251 252	26A 26B	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 2	253	26C	Max Current Alarm Threshold
	Power Factor - Outlet 2	254 255	26D 26E	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 3	256	26F	Max Current Alarm Threshold
	Power Factor - Outlet 3	257 258	270 271	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 4	259	272	Max Current Alarm Threshold
	Power Factor - Outlet 4	25A 25B	273 274	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 5	25C	275	Max Current Alarm Threshold
	Power Factor - Outlet 5	25D 25E	276 277	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 6	25F	278	Max Current Alarm Threshold
	Power Factor - Outlet 6	260 261	279 27A	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 7	262	27B	Max Current Alarm Threshold
	Power Factor - Outlet 7	263 264	27C 27D	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 8	265	27E	Max Current Alarm Threshold
	Power Factor - Outlet 8	266 267	27F 280	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Total Current	268	281	Max Current Alarm Threshold

Category	***Name***	***MPU Address***	***Description***
Alarm Masks	Common Alarm Mask for Status Registers	282	Alarm Mask for Common Status
	Common Alarm Mask for Alarm DIO4	283	Alarm Mask for Common Alarm DIO4
	WB Alarm Mask for Status Registers	284	Alarm Mask for WB Status
	WB Alarm Mask for Alarm DIO4	285	Alarm Mask for WB Alarm DIO4
	NB Alarm Mask for Status Registers	286	Alarm Mask for NB Status
	NB Alarm Mask for Alarm DIO4	287	Alarm Mask for NB Alarm DIO4
Sensor Scaling	Voltage - V(A) Voltage - V(B) Current -Outlet 1 Current - Outlet 2 Current - Outlet 3 Current - Outlet 4 Current - Outlet 5 Current - Outlet 6 Current - Outlet 7 Current - Outlet 8	200 201 202 203 204 205 206 207 208 209	VMAX A VMAX B IMAX Outlet 1 (IA) IMAX Outlet 2 (IB) IMAX Outlet 3 (IC) IMAX Outlet 4 (ID) IMAX Outlet 5 (IE) IMAX Outlet 6 (IF) IMAX Outlet 7 (IG) IMAX Outlet 8 (IH)
Cost Factor	Cost	20E 20F	Cost per KWh Cost Unit string
Calibration	Calibration Configuration Parameters	21D 21E 21F 220 221 222 223 224 225 226 227 228 229 22A 22B 22C 22D 22E 22F	Calibration Status Unused Tolerance on Phase Calibration Calibration Type Calibration Voltage (Target) Calibration Current (Target) Calibration Phase (Target) Tolerance on Voltage Calibration Tolerance on Current Calibration Average Count for Voltage Average Count for Current Max Iterations for Voltage Max Iterations for Current Tolerance on Watts Calibration Average Count for Watts Max Iterations for Watts Calibration WRATE Calibration Temperature Calibration Wattage (Target)
Creep Threshold	**Voltage (VA)** **Voltage (VB)** **Current -Outlet 1** **Current - Outlet 2** **Current - Outlet 3** **Current - Outlet 4** **Current - Outlet 5** **Current - Outlet 6** **Current - Outlet 7** **Current - Outlet 8** **Frequency**	230 231 232 233 234 235 236 237 238 239 23A 23B-23F	VA creep VB creep Imin(IA) - "creep" or squelch level Imin(IB) - "creep" or squelch level Imin(IC) - "creep" or squelch level Imin(ID) - "creep" or squelch level Imin(IE) - "creep" or squelch level Imin(IF) - "creep" or squelch level Imin(IG) - "creep" or squelch level Imin(IH) - "creep" or squelch level VA min for Freq creep Unused

4.2.1.4 CE Library Inputs

The following inputs can only be modified (and saved to Flash) using API calls (no direct SPI access). For more information on register descriptions, refer to the 6618_PDU_S8_URT_V1_00 Firmware Description Document.

CATEGORY	CE ADDRESS	DESCRIPTION
Calibration	10 - 17	Calibration Gain IA-IH (Outlet 1-8)
	18,19	Calibration Gain VA, VB
Phase Adjust	1A - 21	Phase Adjust IA - IH
CE Configuration	22	CE State
Pulse Rate	23	Wrate
Quantization Corrections	25 - 2C	Quantization offset Outlet 1 to Outlet 8
	35 – 3C	Quantization offset IA - IH (Outlet 1-8)
Temperature Compensation	3D	Temperature Gain Adjust
SAG Detection	3E	SAG Threshold on VA
	3F	SAG Threshold on VB
More Temperature Compensation	40	Degree Scale
	41	ppm / ˚c
	42	ppm / ˚c^2
	43	Temperature Calibration Value

4.3 Flash Management

4.3.1 Memcpy_rx()

Purpose	Write to Flash the content data from a specific RAM location. If the length of the source and the starting ROM location cause the write operation to span more than one 1024-byte Flash page, the Read/Erase/Verify/Write will take place on all the pages involved. An erase operation will result in the Flash contents being set to 0xFF. CE will be disabled during execution of this API. After the write, this API will validate the write by comparing the Flash content against the RAM content and the return code is reflected from this comparison.

Note1: When calling this API, CE must be turned off. See `MAPI_CEOff` and `MAPI_CEOn` APIs in the sections above.

Note2: it is the task of the application to setup the specific Flash bank before calling this API. An example use of this API is as follows:

```
 FL_BANK = BANK_CE;
ok = memcpy_rx ((int8r_t *) ROMData, (int8x_t *) RAMData, ROMSIZE);
FL_BANK = saved_bank;
```

Where `FL_BANK` is SFR 0xB6; and `BANK_CE` is defined to be Bank 3.

Synopsis

```
Bool memcpy_rx ( Unsigned char code *dst,
                 Unsigned char xdata *src,
                 Unsigned integer len );
```

Parameters

`dst`	Input parameter. Specifies starting ROM address of Flash to be written (destination).
`src`	Input parameter. Use contents at this RAM address location as the source data.
`len`	Input parameter. Length (in bytes) of data to write to Flash.

Return Codes

TRUE if the Write was successful.
FALSE if the Write was not completed.

Note: To avoid accidental write to Flash, this function requires a ‘flash write’ confirmation from the application layer. This confirmation is done such as follows: there shall be a function called `get_buff()`, at application level, which returns a pointer of Xdata whose content is checked as the following:

```
uint8x_t  xdata *bptr;
  bptr = get_buff ();

  if ((']' == toupper (*(bptr + 0)) && 'U' == toupper (*(bptr + 1))) ||
      (')' == toupper (*(bptr + 0)) && 'U' == toupper (*(bptr + 1))) ||
      ('C' == toupper (*(bptr + 0)) && 'A' == toupper (*(bptr + 1))) ||
      ('C' == toupper (*(bptr + 0)) && 'L' == toupper (*(bptr + 1))) ||
      ('C' == toupper (*(bptr + 1)) && 'C' == toupper (*(bptr + 2))) ||
      ('U' == toupper (*(bptr + 1)) && 'C' == toupper (*(bptr + 2))) ||
      ('U' == toupper (*(bptr + 1)) && 'M' == toupper (*(bptr + 2)))
       )
```

4.3.2 Memcpy_xr()

Purpose

Use to write to Flash the content data to a specific RAM location. Note, it is the task of the application to setup the specific Flash bank before calling this API. An example use of this API is as follows:

```
    FL_BANK = BANK_CE;
    memcpy_xr (RAMData, ROMData, ROMSIZE);
    FL_BANK = saved_bank;
```

Where `FL_BANK` is `SFR 0xB6`; and `BANK_CE` is defined to be `Bank 3`.

Synopsis

```
Void memcpy_xr ( Unsigned char xdata *dst,
                 Unsigned char code *src,
                 Unsigned integer len );
```

Parameters

`dst`	Input parameter Specifies starting RAM address to be written (destination).
`src`	Input parameter Use contents at this ROM/Flash address location as the source data.
`len`	Input parameter Length (in bytes) of data to write to RAM.

Return Codes

TRUE if the Write was successful.
FALSE if the Write was not completed.

4.3.3 Memcpy_xx()

Purpose

Use to copy data from an xdata location to another xdata location.

Synopsis

```
Void memcpy_xx ( Unsigned char xdata *dst,
                 Unsigned char xdata *src,
                 Unsigned integer len );
```

Parameters

`dst`	Input parameter Specifies starting RAM address to be written (destination).
`src`	Input parameter Use contents at this RAM address location as the source data.
`len`	Input parameter Length (in bytes) of data to write to RAM.

Return Codes

None.

4.3.4 MAPI_UpdateMPU()

Purpose	Update the MPU contents permanently into Flash. The MPU measurement input and calibration default values are stored in Flash. During power up, this content is copied to XRAM to be used as a working copy. The application can change some of the values using the `MAPI_GetSetRegister()`. This change only takes effect in the XRAM copy of the data. To permanently save the data into Flash, the application must exclusively call this function to perform the permanent save. This function is not to, and should not, be called too often as Flash Write does have a life-expectancy. It is typically used after the part is calibrated successfully to save the coefficient values. See the 6618_MAPICLIW.uproj for sample usage of this API. In order for this function to perform properly, the CE must be turned off by calling `MAPI_CEOff()`.
Synopsis	`Bool` **`MAPI_UpdateMPU`** `( void );`
Parameters	none
Return Codes	TRUE – Successful write of MPU data to Flash. FALSE – Write was not successful; perhaps CE is still running.

4.3.5 MAPI_UpdateCE()

Purpose	Update the CE Data contents permanently into Flash. The CE Data Image is programmed into Flash, starting at address 0xDFFE. During power up, its content is copied to XRAM to be used as a working copy. Though it is NOT recommended to change any CE Data, occasionally such needs arise, such as changing the IMAX, VMAX or WRATE values. The application can change the values of these configurable registers using the `MAPI_GetSetRegister()`. This change only takes effect in the XRAM copy of the data. To permanently save the data into Flash, the application must exclusively call this function to perform the permanent save into its specific location of Flash. This function is not, and should not, be called too often as Flash Write does have a life-expectancy. See the 6618_MAPICLIW.uproj for sample usage of this API. In order for this function to perform properly, the CE must be turned off by calling `MAPI_CEOff()`.
Synopsis	`Bool` **`MAPI_UpdateCE`** `( void );`
Parameters	None.
Return Codes	TRUE – Successful write of MPU data to Flash. FALSE – Write was not successful; perhaps CE is still running.

4.3.6 MAPI_CEOn()

Purpose	Turn CE on. After calling `MAPI_Init()`, CE is turned on. This API is available to the application to manually control the CE, particularly when reading/writing to Flash (writing to Flash is not allowed when CE is on).
Synopsis	`void` **`MAPI_CEOn`** `( void );`
Parameters	None.
Return Codes	None.

4.3.7 MAPI_CEOff()

Purpose	Turn CE off. When writing to flash, the CE must be turned off. This API is necessary with `MAPI_UpdateCE`, `MAPI_UpdateMPU` or `memcpy_rx` calls.
Synopsis	`void` **`MAPI_CEOff`** `( void );`
Parameters	None.
Return Codes	None.

4.4 Calibration

4.4.1 MAPI_CalSetGet()

Purpose

Set or Get Calibration reference and tolerance parameters as specified in the `MPU_CParms_t` structure. New values are kept in RAM only. When all calibration data is setup and calibrated correctly, it can be kept and recorded, permanently in Flash by calling `MAPI_UpdateCE()` and `MAPI_UpdateMPU()`.

A typical calibration of the part proceeds as follows:

1. Call `MAPI_CalSetGet (FALSE, ….)` to get current calibration data.
2. If necessary, call `MAPI_CalSetGet (TRUE,…)` to set new calibration data (tolerance values, referenced values, etc.).
3. Call `MAPI_Calibrate()` to start the calibration. If calibration passes, continue to step 4. If calibration fails, repeat step 1.
4. Call `MAPI_UpdateCE()` and `MAPI_UpdateMPU()` to permanently update the new values in Flash.
5. Call `MAPI_CalSetGet (FALSE,…)` to make sure the new data is written, preserved and correct.

Synopsis

```
MAPI_RC  MAPI_CalSetGet(IN unsigned char SetData,
                        Struct MPU_CParms_t  *MAPI_CParams);

Struct MPU_CParms_t

{
    uint8_t    C_Tcal;   // Type calibration. Read-Only.
    float      C_Wcal;   // Wattage calibration target (Watts).
    float      C_Vcal;   // Voltage calibration target (Vrms).
    float      C_Ical    // Current calibration target (Arms).
    int16_t    C_Pcal;   // Phase calibration target (Degrees).

    float      C_Wtolerance;  // Watts Tolerance (Watts).
    float      C_Vtolerance;  // Voltage Tolerance (Vrms).
    float      C_Itolerance;  // Current Tolerance (Arms).
    float      C_Ptolerance;  // Phase Tolerance (degrees).

    uint8_t    C_Vavg_cnt;    // Voltage Average count.
    uint8_t    C_Iavg_cnt;    // Current Average count.
    uint8_t    C_Wavg_cnt;    // Watts Average count.

    uint16_t   C_Vmax_cnt;    // Voltage Max count.
    uint16_t   C_Imax_cnt;    // Current Max count.
    uint16_t   C_Wmax_cnt;    // Watts Max count.

    uint16_t   C_Wrate_cal;   // Wrate during calibration
(~.32Kh).  Read-Only
    uint16_t   C_Tempcal;     // Calibration temperature (0.1
degree).
};
```

Parameters	`SetData`	Input parameter. TRUE(1) – Set calibration data as specified in `MPU_CParms_t`. FALSE(0) – Get current calibration data and return values in `MPU_CParms_t`.

MAPI_CParams:

`C_Tcal`	Input parameter – read-only. Calibration type. None(0x00).
`C_Wcal`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Referenced Wattage calibration value (in Watts). Default = 120W.
`C_Vcal`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Referenced Voltage calibration value (Vrms) . Default = 120V.
`C_Ical`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Referenced Current calibration value (Arms). Default = 1A.
`C_Pcal`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Referenced Phase calibration value (in 0.1 C Degrees). Default = 0 degree.
`C_Wtolerance`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE). Watts Tolerance (Watts). Default = 0.01W or 10mW.
`C_Vtolerance`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Voltage Tolerance (Vrms). Default = 10mV.
`C_Itolerance`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Current Tolerance (Arms). Default = 10mA.
`C_Ptolerance`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Phase Tolerance (degrees). Default = 0.1 Degree.
`C_Vavg_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Voltage Average count. Default = 3.
`C_Iavg_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Current Average count. Default = 3.
`C_Wavg_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Watts Average count. Default = 3.
`C_Vmax_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Maximum number of voltage reads to test for pass/fail result. Default = 10.
`C_Imax_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Maximum number of current reads to test for pass/fail result. Default = 10.
`C_Wmax_cnt`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE) Maximum number of Watts reads to test for pass/fail result. Default = 10.
`C_Wrate_cal`	Output parameter. Wrate use during calibration (~.32kh). Read-only.
`C_Tempcal`	Output parameter (SetData = FALSE), Input parameter (SetData = TRUE). Calibration temperature. In 0.1 degree unit.

Return Codes	MAPI_OK	//Calibration succeeded.
	MAPI_ERROR	//Calibration failed. //For more detailed descriptions of the failure, call `MAPI_CALStatus()`.

4.4.2 MAPI_Calibrate()

Purpose

Calibrate the part using referenced meter values and tolerance values as specified in the `MPU_CParms_t` data structure (see the `MAPI_CalSetGet` API for more information).

A typical application shall use this API as follows:

1. Call `MAPI_CalSetGet (FALSE, ….)` to get current calibration data.
2. If necessary, call `MAPI_CalSetGet (TRUE,…)` to set new calibration data (tolerance values, referenced values, average count, maximum count, etc.).
3. Call `MAPI_Calibrate()` to start the calibration.
4. Call `MAPI_UpdateCE()` and `MAPI_UpdateMPU()` to permanently update the new values in Flash.
5. Call `MAPI_CalSetGet (FALSE,…)` to make sure the new data is written/preserved.

It is up to the application level to select the CAL_TYPE appropriately. It is recommended that temperature calibration (CTYPE = C_TEMP) shall always be part of CAL_TYPE; thus, C_TEMP shall always be OR'ing with c_type. When this API is called with multiple CAL_TYPEs, calibration will be done in the following order:

Temperature,
Phase,
Voltage,
Current,
Wattage.

Make sure the referenced values are setup correctly, using `MAPI_CalSetGet();` otherwise, calibration will not pass. See Section 4 for default values.

When the return code is not MAPI_OK, call `MAPI_CalStatus()` to get detailed descriptions of the calibration error(s). If an error occurs during this call, the part is NOT calibrated. It is the task of the application to call this API again if recalibration of the part is necessary.

Synopsis

```
MAPI_RC  MAPI_Calibrate(IN enum CAL_TYPE c_type,
                        IN Unsigned Char Outlets);
```

Parameters	`c_type`	Input parameter.
		The following types are acceptable:
		`Enum CAL_TYPE {`
		`C_WATT   =  0x01 – Calibrate Wattage.`
		`C_VOLT   =  0x02 – Calibrate Voltage.`
		`C_CURRENT      =  0x04 – Calibrate Current.`
		`C_PHASE  =  0x08 – Calibrate Phase Adjust.`
		`C_TEMP   =  0x10 –  Calibrate Temperature.`
		`}`
		Calibration source. The values can be OR'ing. For example: `C_WATT` **|** `C_VOLT` indicate calibration to be done on Voltage and Wattage; `C_TEMP` **|** `C_VOLT` indicate calibration to be done on Voltage and Temperature.

	`Outlets`	Input parameter Bit representations of outlet # to be calibrated. For example: 0x03 represents outlet #1 and 2 to be calibrated. 0xFF represents all eight outlets to be calibrated.
Return Codes	MAPI_OK	//Calibration passed.
	MAPI_ERROR	//Calibration failed. Call `MAPI_CalStatus()` for specifics.

4.4.3 MAPI_GetVoltageCurrent()

Purpose

Get the present values of Voltage and Current . This function can be useful for determining referenced voltage and current values for calibration. Follow the steps below for a sample usage of this API:

1. Call `MAPI_CalSetGet()` to get default calibration values and present chip temperature.
2. Call `MAPI_GetVoltageCurrent()` to get the Voltage and Current at the IC inputs
3. Set new target Voltage and Current parameters, if needed, correlating to the values obtained in step 2 with a call to `MAPI_CalSetGet()`.
4. Call `MAPI_Calibrate()` to start the calibration.
5. As a check call `MAPI_GetVoltageCurrent()` to confirm new calibrated values.

Synopsis

```
void  MAPI_GetVoltageCurrent( OUT struct VIT_t  *VIT_Params);
```

Where `VIT_t` is defined as:

```
struct VIT_t
{
   Unsigned char Channel;
   float Current_I;
   float Current_V;
};
```

Parameters

`Channel`	Input parameter. Channel/outlet number (1 through 8) where present Current value will be read.
`Current_I`	Output parameter. Present value of Current for the specified outlet.
`Current_V`	Output parameter Present value of Voltage for Voltage A.

Return Codes None.

4.4.4 MAPI_CalStatus()

Purpose: Run this function if `MAPI_Calibrate` returns error code to get the exact status of the failure(s).

Synopsis:

```
void   MAPI_CalStatus ( unsigned long CAL_Status );
```

Parameters: `Cal_Status` Output parameter.

A 32-bit word status that indicates statuses as follows:

Voltage A Cal failed	Bit 1 = 1
Voltage B Cal failed	Bit 2 = 1 (N/A at present time)
Phase A Cal failed	Bit 3 = 1
Current A/outlet 1 Cal failed	Bit 4 = 1
Watt A/outlet 1 Cal failed	Bit 5 = 1
Phase B Cal failed	Bit 6 = 1
Current B/outlet 2 failed	Bit 7 = 1
Watt B/outlet 2 failed	Bit 8 = 1
Phase C Cal failed	Bit 9 = 1
Current C/outlet 3 failed	Bit 10 = 1
Watt C/outlet 3 failed	Bit 11 = 1
Phase D Cal failed	Bit 12 = 1
Current D/outlet 4 failed	Bit 13 = 1
Watt D/outlet 4 failed	Bit 14 = 1
Phase E Cal failed	Bit 15 = 1
Current E/outlet 5 failed	Bit 16 = 1
Watt E/outlet 5 failed	Bit 17 = 1
Phase F Cal failed	Bit 18 = 1
Current F/outlet 6 failed	Bit 19 = 1
Watt F/outlet 6 failed	Bit 20 = 1
Phase G Cal failed	Bit 21 = 1
Current G/outlet 7 failed	Bit 22 = 1
Watt G/outlet 7 failed	Bit 23 = 1
Phase H Cal failed	Bit 24 = 1
Current H/outlet 8 failed	Bit 25 = 1
Watt H/outlet 8 failed	Bit 26 = 1

Return Codes: None.

4.5 Zero Crossing and Relay Control

4.5.1 MAPI_RelayConfig()

Purpose Read/Write relay configuration values. Relay configuration is applicable to all channels/outlets.

Synopsis `void` **`MAPI_RelayControl( IN Bool Operation, OUT/IN struct Relay_Config_t Relay_Config)`**`;`

Where `Relay_Config_t` is defined as:

```
struct Relay_Config_t

{
   Unsigned Char        Relay_CTL;
   Unsigned Integer     SeqDlyTime;
   Unsigned Integer     DeEnergizedTime;
   Unsigned Integer     EnergizedTime;
   Unsigned Char        InvertPNonLatch;
};
```

Parameters `Operation` Input parameter.

TRUE (1) = set operation. FALSE (0) = get operation, Relay_Config will all be output parameter.

When `Operation` = TRUE:

`Relay_CTL`	Output parameter. This parameter is output only. It is set via `MAPI_RelayControl()`.
`SeqDlyTime`	Input parameter. Set the new Sequence Delay Time in 10ms units. Delay time is time between turning Relays ON (close circuit). Default value is 10 ➔100ms.
`DeEngergizedTime`	Input parameter. Time in mseconds + 1msecond to delay after open circuit.
`EngergizedTime`	Input parameter. Time in msecond + 1msecond to delay after close circuit.
InvertPolarity	Input parameter. Bit 1 = Polarity (0 = non-inverted). Bit 0 = Latch type (0 = non-latched).

Notes:

Sequence Delay Time will be used between turning relays ON.

Energized Delay Time is used as the delay time to wait immediately after a zero-crossing before close circuit.

DeEnergized Delay Time is used as delay time to wait immediately after a zero-crossing before open circuit.

Return Codes None.

4.5.2 MAPI_RelayControl ()

Purpose Turning Relay ON/OFF (close/open circuit) on all eight channels.

Synopsis `void MAPI_RelayControl( IN unsigned char Channels);`

Parameters `Channels` Input parameter.
Each bit indicates turning ON(1) or OFF(0). The bit's position represents the specific channel/outlet number. For example:

0x01h – Turn relay ON on channel 1/A. Turn relays OFF all other channels.
0x02h – Turn relay ON on channel 2/B. Turn relays OFF all other channels.
0x04h – Turn relay ON on channel 3/C. Turn relays OFF all other channels.
0x08h – Turn relay ON on channel 4/D. Turn relays OFF all other channels.
0x10h – Turn relay ON on channel 5/E. Turn relays OFF all other channels.
0x20h – Turn relay ON on channel 6/F. Turn relays OFF all other channels.
0x40h – Turn relay ON on channel 7/G. Turn relays OFF all other channels.
0x80h – Turn relay ON on channel 8/H. Turn relays OFF all other channels.
Multiple channels can be turned ON with a single call to this API by setting 1 at the bits representing the channels. For example:
0x81h – Turn relay ON on channels 1&8/A&H. Turn relays OFF all others.
0xFFh – Turn relay ON on all channels.
0x00h – Turn relay off of all channels.
0x0Fh – Turn relay ON on all 4 lower channels and OFF of all 4 higher channels
0xF0h – Turn relay ON on all 4 higher channels and OFF of all 4 lower channels

Return Codes None.

4.5.3 MAPI_CloseCircuit_0X()

Purpose Get zero-crossing status when positioning from open circuit to close circuit. The value returned TRUE/FALSE indicates whether Voltage zero-crossing has occurred. The usage of this API is intended to be for when the circuit is transitioning from open to close. This API uses the hardware Timer 1 in the case when zero crossing does not take place. A delay of 20ms is set for such break.

Synopsis `bool MAPI_CloseCircuit_0X( void );`

Parameters None.

Return Codes TRUE – Zero crossing occurs.
FALSE – Zero crossing does not occur.

4.5.4 MAPI_OpenCircuit_0X()

Purpose	Get zero-crossing status when transitioning from close circuit to open circuit. The value returned TRUE/FALSE indicates whether current zero-crossing has occurred for a specific channel. There is no indication of either direction. The usage of this API is intended to be for when the circuit is transitioning from close to open. This API uses the hardware Timer 1 in the case when zero crossing does not take place. A delay of 12ms is set for such break.
Synopsis	`bool` **`MAPI_OpenCircuit_0X( unsigned char Channel );`**
Parameters	`Channel` Input parameter. Channel/outlet number (1 through 8) where zero crossing will be detected.
Return Codes	TRUE – Zero crossing occurs. FALSE – Zero crossing does not occur.

4.6 Soft-Timers

There are eight soft-timers in the 8051 Timer 0. Only six of these timers are available to application level as two are used internally by the library. The timer is a fixed 10-milisecond time increment. When `TSC_Init()` is called, the timer will be started and setup. It also calls `MAPIstm_init()` so the application layer does NOT need to call `MAPIstm_init()`.

4.6.1 MAPIstm_init()

Purpose	Initialize soft-timers variables and structures.
Synopsis	`void` **`MAPIstm_init ( void )`**`;`
Parameters	None.
Return Codes	None.

4.6.2 MAPIstm_fn_start()

Purpose: Start a soft-timer with a call-back function pointer. Upon expiration of the timer, execute the function then remove/free the timer.

Synopsis:

```
unsigned integer  *MAPIstm_fn_start (unsigned integer tenms_count,
                                      void (code *fn_ptr) (void))
```

Parameters:

`tenms _count`	Input parameter. Number of counts (in 10ms units) passed to execute the call back function fn_ptr.
`*fn_ptr`	Input parameter. Pointer to the call-back function to execute when the `tenms_count` has expired. The function should be a reentrant.

Return Codes: NULL_PTR: if there is no more soft-timer available. Or,

The address of where `tenms_count` value is stored, and counted down, is returned. This is useful when the application needs to stop the timer at any time before it is expired.

4.6.3 MAPIstm_run()

Purpose	Keep the soft-timers updated and current. This API shall be called in the application's main loop after `MAPIstm_fn_start()` is used. This is where `fn_ptr (in MAPIstm_fn_start()` above) is processed.
Synopsis	`void` **`MAPIstm_run ( void )`**`;`
Parameters	None.
Return Codes	None.

4.6.4 MAPIstm_wait()

Purpose	Delay processing for a fixed time (in 10ms increment). Typically use when it is necessary to wait for something to stabilize.	
Synopsis	`void` **`MAPIstm_wait ( IN unsigned integer DelayTime )`**`;`	
Parameters	`DelayTime`	Input parameter Wait (hold up CPU processing) for `DelayTime` * 10ms.
Return Codes	None.	

4.7 Miscellaneous APIs

4.7.1 MAPI_GetCEName()

Purpose	Get the CE name embedded as part of the CE data. The CE name size is 24 bytes and these exact 24 bytes will be returned in the XDATA string pointed to by `ptr`.	
Synopsis	`void` **`MAPI_GetCEName`** `( unsigned char xdata *ptr );`	
Parameters	`ptr`	Output parameter. The CE name will be returned at the `xdata` location pointed to by `ptr`. For version 1.00 CE release, the string will look as follows: CE6618_PDU_S8_A01_V1_0.
Return Codes	None.	

4.7.2 MAPI_SoftReset()

Purpose	Reset the MPU, this includes stopping the CE, and setting all registers to hardware Power-On Reset values.
Synopsis	`void` **`MAPI_SoftReset ( Void )`**`;`
Parameters	None.
Return Codes	None.

4.8 Serial/RS232 Interface

4.8.1 MAPI_UARTInit()

Purpose	Configure the communication speed, flow control, character parity and number of stop bits. The serial interrupt service routine is NOT maskable, the interrupt vector is set internally. Xon/Xoff will always be enabled. Non-parity, 8 data bit, 1 stop bit is the only supported configuration. The only thing the application can change is the baud rate.
Synopsis	**`Bool MAPI_UARTInit (`** `IN enum SERIAL_SPD speed)`
Parameters	`speed`: Input parameter This selects the communication speed. Possible values are:

```
_RATE_300       0
_RATE_600,      1
_RATE_1200,     2
_RATE_2400,     3
_RATE_4800,     4
_RATE_9600,     5
_RATE_19200,    6
_RATE_38400,    7 (default)
```

Return Codes None.

4.8.2 MAPI_UARTTx()

Purpose	Setup the Tx buffer before sending data to the PC UART. Subsequent call to this API will append the buffer to the existing transmittal buffer. An application should call this API immediately after calling `MAPI_UARTInit()`.
Synopsis	**`enum SERIAL_RC data MAPI_UARTTx (`** `U08x xdata *buffer, U16 len` **`)`**
Parameters	`buffer` Input parameter. Specifies a pointer to the data buffer containing data to send to the PC UART. `Len` Input parameter. Specifies the current number of bytes to be sent.
Return Codes:	S_EMPTY Successful transmission. S_PENDING, Successful transmission thus far but not yet finished. Where return code `SERIAL_RC` is defined as**:** `Enum SERIAL_RC`.

After calling this API, an application can make sure all bytes were transmitted by checking that `MAPI_TxLen()` returns a 0.

4.8.3 MAPI_TxLen()

Purpose	Number of bytes transmitted thus far.
Synopsis	**`Unsigned integer MAPI_ TxLen (`** `void` **`)`**
Parameters	None.
Return Value	Unsigned integer specifying the number of bytes left in the Tx buffer, i.e. the remaining bytes to be sent.

4.8.4 MAPI_UARTRx()

Purpose	Setup the receive buffer and start receiving. Always call this function after `MAPI_UARTInit()` to make sure the receive buffer is available. Subsequent call to this API will append the data to the existing buffer queue, if data is being received.	
Synopsis	**`uint16_t MAPI_UARTRx (`** `U08x xdata *buffer, U16 len` **`)`**	
Parameters	`buffer`	Input parameter. Specifies a pointer to the data buffer to store the data received from the PC UART.
	`len`	Input parameter. Specifies the maximum number of bytes to receive at any one time.
Return Codes	Unsigned integer specifying the number of bytes fetched thus far. Use `MAPI_RxLen()` to keep track of the remaining number of bytes unfetched in the Rx buffer.	

4.8.5 MAPI_RxLen()

Purpose	Number of bytes received thus far.
Synopsis	**`Unsigned Integer MAPI_ RxLen (`** `void` **`)`**
Parameters	None.
Return Value	Unsigned integer specifying the number of bytes in the queued buffer.

4.9 SPI Interface

78M6618 have dedicated segment-pins SEG3(PCLK),SEG4(PSDO),SEG5(PCSZ) and SEG6(PSDI) for SPI interface. When SPI interface is used for communication, these pins should not be used for other purpose.

4.9.1 MAPI_SPIInit()

Purpose	Initializes the SPI interface, enables the hardware port and interrupt, and initializes the required SPI registers.
Synopsis	**`void MAPI_SPI_init ( void )`**
Parameters	None
Return Codes	None.

4.9.2 MAPI_SPICmd_Pending()

Purpose	Indicates whether the MPU has received a new SPI command.
Synopsis	**`bool MAPI_SPICmd_Pending()`**
Parameters	None
Return Codes	TRUE - A SPI command is waiting to be processed. FLASE - There is no pending SPI command.

4.9.3 MAPI_SPIGet_Cmd()

Purpose: This MAPI returns the command code and data for the currently pending SPI command.

Synopsis: **`void MAPI_SPI_get_cmd(struct spi_cmd_param *cmd_param)`**

Where spi_cmd_param is defined as

```
struct spi_cmd_param
{
      uint8_t cmd_s;
      uint32_t data_s;
};
```

Parameters: `spi_cmd_param` Output parameter.

`cmd_s`	Contains the value of the pending SPI command, e.g. 0x81(relay control), 0x89(CE off), etc.
`data_s`	Contains the data of the pending SPI commands, if applicable.

Return Codes: None

5 Library Defaults

The following default values are used to build the M-API library:

```
struct MPU_CParms_t  MPU_CParams =
{
    Unsigned Char  Channels = 0
    float    C_Wcal = 120W
    float    C_Vcal = 120V
    float    C_Ical = 1A
    Unsigned Integer t  C_Pcal = 0

    float     C_Wtolerance = 10mA
    float     C_Vtolerance = 10mV
    float     C_Itolerance = 10mA
    float     C_Ptolerance = 0.1 degree

    Unsigned Char C_Vavg_cnt = 3
    Unsigned Char Iavg_cnt = 3
    Unsigned Char C_Wavg_cnt = 3

    Unsigned Integer C_Vmax_cnt = 10
    Unsigned Integer C_Imax_cnt = 10
    Unsigned Integer C_Wmax_cnt = 10

    Unsigned Integer C_Wrate_cal = 2840  (shall not change)
    Unsigned Integer C_Tempcal (read-only)
};

#define DefaultTIQ      10 //Default Time Increment Query
struct VIT_t xdata mapi_tVIT =
{
      0x01,             //Channel 1
      0.00,             //Current_I;
      0.00,             //Current_V;
};

struct Relay_Config_t xdata RlyConfig =
{
      0x00,             //unsigned char Relay_CTL;
      0x64,             //unsigned int SeqDlyTime;
      0x01,             //unsigned int DeEnergizedTime;
      0x01,             //unsigned int EnergizedTime;
      0x00,             //InvertPNonLatch
};
```

Revision History

Revision	Date	Description
1.00	9/15/2010	First publication.